

ROTATING DISKS SLOT MACHINE

Inventor(s)

Robert A. Luciano, Jr.
300 Sierra Manor Drive
Reno, NV 89511

Alex J. Malavanos
882 Meadow Vista
Carson City, Nevada 89705

Gregory A. Malavanos
882 Meadow Vista
Carson City, Nevada 89705

Constantine Malavanos
882 Meadow Vista
Carson City, Nevada 89705

Assignee:

Sierra Design Group
300 Sierra Manor Drive
Reno, Nevada 89511

Entity:

Small

Attorneys for Applicant(s):

Ryan A. Heck
Ian F. Burns & Associates, P.C.
1575 Delucchi Lane
Suite 222
Reno, NV 89502

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[01] ROTATING DISKS SLOT MACHINE

[02] CROSS REFERENCE TO RELATED APPLICATIONS

[03] This application is a continuation application of co-pending U.S. patent application serial
10 number 09/638,666, filed on August 14, 2000. That application is a continuation application of
co-pending U.S. patent application serial number 09/212,108, filed on December 15, 1998, now
U.S. patent number 6,105,962 and is a continuation-in-part application of U.S. patent application
number 09/527,705, filed on March 17, 2000, which claims priority of provisional patent
application number 60/126,052, filed on March 23, 1999.

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[04] TECHNICAL FIELD

[05] This invention relates to amusement devices and more particularly to gaming apparatus
of the type in which a player's score or winnings is determined by rotatable members which carry
20 indicia and which separately spin about a common axis and then come to rest at any of a plurality
of different angular orientations to determine the player's score or winnings.

[06] BACKGROUND OF THE INVENTION

25 **[07]** The traditional slot machine has a series of annular reels disposed in side by side
relationship that rotate separately about a common axis. Player's scores or winnings are indicated
by indicia on the peripheral surfaces of the reels which may align in any of a number of different

5 combinations following a period of rotation of the reels. Players of gaming apparatus typically find it enjoyable to have a variety of different forms of gaming apparatus available. For this purpose, slot machines of the spinning reel type have been provided with a variety of different graphics, cabinet configurations and other varied embellishments such as varying visual or sound effects and differing scoring systems for example. Modification of slot machines of this kind to
10 enhance player enjoyment are circumscribed if the above described basic geometry of mechanical components of the apparatus is retained. The side by side reel arrangement has in the past imparted an undesirable degree of similarity to slot machines of this type notwithstanding the superficial variations of the above described kind.

[08] It has heretofore been proposed to make a basic change in the geometry of the slot
15 machine by replacing the side by side reels with concentric rotating disks which turn about a common axis and which face the operator of the slot machine. Annular bands of differing indicia on faces of the disks are of progressively greater diameter. A player's score is determined by alignment of particular combinations of the indicia along a payline which extends radially relative to the axis of rotation of the disks. As heretofore envisioned, slot machines of this kind
20 have required an undesirably complex construction in order to support and drive the disks and to position the faces of the disks in a coplanar relationship.

[09] The present invention is directed to overcoming one or more of the problems discussed above.

25 [10] SUMMARY OF ONE EMBODIMENT OF THE INVENTION

[11] In one aspect, the present invention provides gaming apparatus having a plurality of rotatable disks centered on a common axis of rotation, each disk being separately rotatable about

5 the axis of rotation. Each disk has an annular band of indicia thereon which encircles the axis of rotation. A player's score is determined by arrival of particular indicia at particular locations following a period of rotation of the disks. The band of indicia of each disk is on a face of the disk which extends inward toward the axis of rotation. Each disk has a peripheral region which of greater diameter than the band of indicia on the disk and preferably each has an annular band
10 of gear teeth at the peripheral region of the disk, which band of gear teeth is centered on the axis of rotation. Preferably, each band of gear teeth is engaged by a separate one of a plurality of drive gears and a separate one of a plurality of drive motors is coupled to each drive gear to turn the gear.

[12] In a preferred embodiment of the invention, the gaming apparatus further includes a
15 plurality of disk positioning gear sets situated at the peripheries of the rotatable disks at intervals around the axis of rotation thereof. Each gear set includes a motor driven shaft with one of the drive gears being on the shaft and being rotated thereby and a plurality of idler gears on the driven shaft which are rotatable relative to the shaft. The drive gear of each gear set engages the gear teeth of a separate one of the rotatable disks. The idler gears of each gear set engage the
20 teeth of the ones of the rotatable disks that are not engaged by the drive gear of the drive gear set. Thus the gear sets at the peripheries of the rotatable disks preferably support and position the disks in addition to driving the disks.

[13] Another aspect the invention preferably provides gaming apparatus having a plurality of disks which are centered on a common axis of rotation, each disk being separately rotatable
25 about the axis of rotation. Each disk has an annular band of indicia thereon which encircles the axis of rotation, the indicia being on faces of the disks which extend inwards towards the axis of rotation. A player's score is determined by arrival of particular indicia at particular locations

5 following a period of rotation of the disks. Each disk is supported by a separate one of a plurality of telescoped drive shafts which preferably extend along the axis of rotation and a separate drive motor is coupled to each said drive shafts. The faces of the disks at which the bands of indicia are located preferably are spaced apart in a direction parallel to the axis of rotation.

10 [14] In still another aspect, the invention preferably provides gaming apparatus having a plurality of rotatable members which are centered on a common axis rotation, each of the rotatable members being separately rotatable about the axis of rotation. Each rotatable member has an annular band of indicia thereon which encircles the axis of rotation, and a player's score is determined by arrival of a particular indicia at particular locations following a period of rotation
15 of the rotatable members. The annular band of indicia of each rotatable member is on a face of the member which extends inward towards the axis of rotation from the perimeter of the member. The annular bands of indicia of the rotatable members are of differing diameters, and portions of at least one rotatable member are in front of the annular band of indicia of another rotatable member. At least portions of the rotatable member that are in front of the annular band
20 of indicia of another rotatable member are formed preferably of transparent material.

[15] The invention preferably is applicable to a form of gaming apparatus which enhances players' enjoyment, as it has a configuration that is distinctly different from traditional slot machines in which indicia are situated on side by side reels. The player views the faces of rotating disks rather than the peripheral surfaces of side by side reels. Indicia align radially
25 relative to the axis of rotation rather than in parallel relation to the axis of rotation as in the traditional slot machine. The general appearance of the moving components during operation is distinctly different from that of the traditional slot machine. These factors preferably create an

5 intriguing ambiance for players of slot machines. The invention preferably provides a simplified and advantageous construction for the disks and disk support, positioning and driving mechanism in gaming apparatus of this kind.

[16] Various embodiments of the invention, together with further aspects and advantages thereof, may be further understood by reference to the following description of the preferred
10 embodiments and by reference to the accompanying drawings.

[17] BRIEF DESCRIPTION OF THE DRAWINGS

[18] FIG. 1 is a perspective view of a slot machine embodying the invention.

15 [19] FIG. 2 is an elevation section view of the upper portion of the apparatus of FIG. 1 taken along the axis of rotation of rotary components of the apparatus.

[20] FIG. 3 is a broken out top view of the upper portion of the slot machine of FIG. 1.

[21] FIG. 4 is a section view taken along line 4--4 of FIG. 3 and which depicts a first gear set of the slot machine.

20 [22] FIG. 5 is a section view taken along line 5--5 of FIG. 3 and which depicts a second gear set of the slot machine.

[23] FIG. 6 is a section view taken along line 6--6 of FIG. 3 and which depicts a third gear set of the slot machine.

[24] FIG. 7 is a broken out side view of the upper portion of a slot machine showing a second
25 embodiment of the invention.

[25] FIG. 8 is a vertical section view of the portion of the mechanism of FIG. 7 that is enclosed by dashed line 8 thereof.

5 [26] FIG. 9 is a front elevation view of the upper portion of a third embodiment of the invention.

[27] FIG. 10 is a broken out side view of the upper portion of the third embodiment of the invention.

10 [28] **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[29] Referring initially to FIGS. 1 and 2 of the drawings, a slot machine 11 in accordance with the first embodiment of the invention has a plurality of rotatable disks which in this example include a front disk 13, an intermediate disk 14 and a rear disk 15 which turn about a common
15 axis of rotation 16 and which have front surfaces 17 which extend inward from the peripheries of the disks towards the axis of rotation. The disks 13, 14 and 15 of this example have similar outer diameters. The front disk 13 is annular with an open center defined by a hub portion 18 of the disk from which the front surface 17 extends in a radially outward direction. Intermediate disk 14 is also annular and has a hub portion 18 of smaller diameter than the hub portion of the front disk
20 13. The rear disk 15 of this example is a flat plate which has no center opening and a conical projection 18a extends from the center of the plate for decorative reasons. These disk configurations enable viewing of an annular region of the front surface 17 of each of the disks by a player who is situated in front of the slot machine 11.

[30] Indicia 19 are imprinted on the visible annular regions 17 of each of the disks 13, 14 and
25 15 and are arranged in annular bands of indicia which are centered on the axis of rotation 16, which are of progressively increasing diameter and which are preferably adjacent to or close to each other in the radial direction on the disks. Individual indicia 19 of each of the disks 13, 14

5 and 15 are spaced at equal angular intervals around the axis of rotation 16. The indicia 19 of each disk 13, 14 and 15 are of a plurality of different designs. The designs may, for example, be the traditional bars, bells, cherries, plums and the like that are found on many prior slot machines or may be other symbols, such as numerals or letters that are distinct from each other. As in other slot machines, a players winnings or score if any is determined by the particular indicia 19 that
10 come to rest or into alignment at a particular location following a period of rotation of the bands of indicia. In contrast to the traditional reel type of slot machine, the payline 20 at which such alignments occur extends radially relative to the axis of rotation 16 rather than in parallel relationship with the axis of rotation. In further contrast to a traditional slot machine, it is possible to have more than one payline 20 as all of the indicia 19 can be visible to the player at
15 the same time.

[31] The disks 13, 14 and 15 of this example are housed in a cabinet 21 behind a transparent circular window 22 of the cabinet. The outermost regions of the disks 13, 14 and 15 are concealed by an annular bezel member 23 situated immediately behind the window 22 and which curves rearwardly towards the front disk 13. Referring to FIG. 1 in particular, the slot machine
20 11 may have a coin receiver 24, a start play switch button 25 and an open coin payout chamber 26. Coin receiver 24 may be replaced with or supplemented by a paper currency or charge card validator and the button switch 24 may be replaced with or supplemented by a switch that is operated by manually pivoting an arm in the manner of the traditional slot machine. A display window 27 situated below the visible portions of the disks 13, 14 16 or elsewhere may display
25 winning combinations of indicia to the player. An electronic display screen 28 of the kind which produces changeable images may be provided on the front of cabinet 21 to display winning combinations of indicia when they occur. The coin receiver 24 and coin processing mechanism

29 may be of one of the known forms. Switch button 25 and the electrical components of the slot machine 11 which respond to operation of the switch may also be of conventional form except as hereinafter described. The slot machine 11 may be embellished with lights, bells and/or other visual and audio effects in the manner known to the art.

[32] Referring jointly to FIGS. 2 and 3, the periphery of each of the rotatable disks 13, 14 and 15 is provided with gear teeth 31. The disks 13, 14 and 15 are positioned, supported and driven by a compact and simple mechanism which includes three gear sets 32a, 32b and 32c which engage gear teeth 31. The gear sets 32a, 32b and 32c are situated adjacent to the peripheral region of the disks 13, 14 and 15 and are angularly spaced apart relative to the axis of rotation 16 of the disks. The angular interval between the gear sets 32a, 32b and 32c around the axis of rotation 16 is less than 180° for reasons which will hereinafter be discussed and is preferably 120° as in this particular example of the invention.

[33] A pair of spaced apart circular support plates, including a forward support plate 33 and rear support plate 34, extend vertically within the upper region of cabinet 21 behind the rotatable disks 13, 14 and 15. Bolts 35 secure the two support plates together. Referring jointly to FIGS. 2 and 4, each of the gear sets 32a, 32b and 32c has a rotatable drive shaft 36 which extends from a back end bearing 37 mounted in the rear support plate 34 through a bushing 38 mounted in the forward support plate 33 to a front end bearing 39 mounted in an annular front structural member 41 which is situated immediately behind the bezel 23 and which has an open center to enable viewing of the disks 13, 14, 15. The drive shaft 36 of each gear set 32a, 32b and 32c is driven by a separate one of three electric motors 42a, 42b and 42c which are situated behind the rear support plate 34 and secured to that support plate. Each such motor 42a, 42b and 42c turns a motor output gear 43 situated between the forward and rear support plates 33 and 34 and which

5 engages a smaller driven gear 44 situated on the drive shaft 36 of the associated one of the gear sets 32a, 32b and 32c at a location between the support plates. The drive shafts 36 are constrained to rotate with the driven gears 44 in this example by keys 46 within the driven gears which seat in longitudinal keyway slots 47 that extend along each drive shaft. Alternately, the driven gears 44 may be locked to the drive shafts 36 by set screws or other means known to the art.

[34] Referring to FIGS. 4, 5 and 6 in conjunction, each of the gear sets 32a, 32b and 32c has three disk support gears disposed along the drive shaft 36 including a front support gear 48, an intermediate support gear 49 and a rear support gear 51. The front support gear 48 engages the teeth 31 of front rotatable disk 13, intermediate support gear 49 engages the teeth 31 of intermediate rotatable disk 14 and the rear support gear 51 engages the teeth 31 of the rear rotatable disk 15. The support gears 48, 49 and 51 are of equal outer diameter in this example of the invention and are proportioned to abut against each other. A tubular sleeve 52 is disposed on each drive shaft 36 in coaxial relationship therewith and extends between bushing 38 and the rear support gear 51 to hold the support gears at the locations along the shaft at which they engage the rotatable disks 13, 14 and 15.

[35] Provided that the angular interval between successive ones of the three gear sets 32a, 32b and 32c around the axis of rotation of the rotatable disks 13, 14 and 15 is less than 180°. as previously described, the support gears 48, 49 and 51 act to hold each of the disks in a centered relationship relative to the axis of rotation. The gear sets 32a, 32b and 32c also function to rotate each of the disks 13, 14 and 15. In particular as shown in FIG. 4, at gear set 32a the front support gear 48 is constrained to rotate with drive shaft 36 by an internal key 53 which seats in the drive shaft keyway slot 47. The other two support gears 49 and 51 at gear set 32a are idler gears which

5 are free to rotate relative to the drive shaft 36. Thus the first gear set 32a both supports and drives the front rotatable disk 13 while serving only as a support for the other rotatable disks 14 and 15.

[36] At the second gear set 32b, as shown in FIG. 5, it is the intermediate support gear 49 that is constrained to rotate with drive shaft 36 by an internal key 53 while the front and rear support gears 48 and 51 are idler gears that may turn relative to the shaft. Thus the second gear set 32b
10 drives the intermediate rotatable disk 14 while also serving as a support for the other two rotatable disks 13 and 15.

[37] With reference to FIG. 6, at the third gear set 32c the rear support gear 51 is constrained to rotate with drive shaft 36 by an internal key 53 with the front and intermediate support gears 48 and 49 being free turning relative to the shaft. Accordingly the third gear set drives the rear
15 rotatable disk 15 while functioning as a support for the other two rotatable disks 13 and 14.

[38] Referring again to FIGS. 2 and 3, the disks and disk support and drive mechanism are unitized by connectors 35 which extend from the annular front structural member 41 to the circular front support plate 33 and the assembly has a maximum diameter that enables insertion and withdrawal of the unitized mechanism through the window opening 22a at the front of
20 cabinet 21 upon removal of the window 22 itself. This facilitates assembly and repairing of the slot machine. The unitized mechanism is positioned at its back end by a support bracket 50 which extends from rear support plate 34 into a socket 55 which is secured to the rear wall of cabinet 21.

[39] With continued reference to FIGS. 2 and 3, the disk drive motors 42a, 42b and 42c are
25 preferably controlled by a microprocessor circuit, contained within a circuit housing 54, which may be of the known design that is commonly used in conventional modern slot machines. The motors 42a, 42b and 42c are brake gear motors of the known stepping form which separately

5 rotate each disk 13, 14 and 15 through a predetermined number of angular increments that is determined by the control circuitry and which varies during successive playings of the slot machine 11. Referring again to FIG. 1, the angular increment through which each disk 13, 14 and 15 is traveled during each step of the rotary movement corresponds to the angular spacing of the centers of successive ones of the indicia 19 about the axis of rotation of the disks. Thus indicia
10 19 of each disk 13, 14 and 15 are in alignment along radii of the axis of rotation when the motors stop turning the disks. The presence of particular indicia 19 or combinations of indicia at payline 20 at that time determines the player's winnings or score in the conventional manner.

[40] Slot machine motor control circuits 54 which are microprocessor controlled require tracking of the rotary movement of the indicia carrying rotatable members by the microprocessor
15 56. For this purpose, tracking means 57 are provided for generating repetitive electrical signal pulses including first, second and third series of pulses each of which is indicative of rotary motion of a separate one of the rotatable disks 13, 14 and 15. Successive pulses in each series are produced in response to successive increments of rotary motion of the disk 13, 14 or 15 that is being tracked by the particular series. In a manner known to the art, this enables the
20 microprocessor 56 to cause stopping of rotation of the members at times when indicia are in alignment at the payline and, by counting the pulses, to determine which indicia are at the payline.

[41] The tracking means 57 of this example of the invention operates by photoelectric sensing of disk motion. Means 57 includes a bracket 58 which extends forward from the front circular
25 support plate 33, past the peripheries of each of the rotatable disks 13, 14 and 15, and into the front structural member 41. Bracket 58 has pairs of spaced apart tangs 59 and the tangs of each pair extend along opposite sides of the gear teeth 31 of a separate one of the rotatable disks 13,

5 14 and 15. One tang 59 of each pair supports a small light source 61 positioned to direct light towards a light detector 62 supported by the other tang of the pair and which is at the other side of the gear teeth 31 of the disk 13, 14 or 15 which extends between the pair of tangs. The light sources 61 may be of any of a variety of types such as light emitting diodes for example. The light detectors 62 may also be of any of a variety of different types, phototransistors and
10 photodiodes being examples.

[42] The gear teeth 31 of each rotatable disk 13, 14 and 16 repetitively pass through the light path between the associated light source 61 and light detector 62. This causes the output signal of the detector 62 to switch repetitively between a high condition and a low condition thereby providing the desired series of rotary motion tracking signal pulses. For reasons to be hereinafter
15 described, the rotatable disks 13, 14 and 15 in their preferred form are made of translucent material. In instances where this results in an undesirably small variation of the light detector 62 outputs in response to the passage of gear teeth 31, the sides of the gear teeth can be coated with paint or other opaque material. It is also possible to situate the light sources 61 and detectors 62 at locations which are closer to the axis of rotation than the peripheral gear teeth 31. The disks
20 13, 14 and 15 may then be provided with bands of light passages separated by relatively opaque areas that travel between the light sources 61 and light detectors 62 as the disks turn.

[43] Movement of the rotatable disks 13, 14 and 15 in a direction parallel to the axis of rotation 16 is prevented by pads 63 which are secured to the ends of the tangs 59 of bracket 58. The pads 63 are preferably formed of a low friction resilient material such as felt. The pads 63 at
25 each pair of tangs 59 extend towards and bear against the sides of the disk 13, 14 or 15 which extends between that pair of tangs. A pair of similar brackets 58a and 58b having pads 63 extend from the front circular support plate 33 to restrain axial movement of the rotatable disks 13, 14

5 and 15 at additional locations which are angularly spaced apart around the axis of rotation 16 of the disks. The brackets 58, 58a and 58b of this particular example of the invention are at 120° angular intervals around the axis of rotation 16.

[44] Referring jointly to FIGS. 1 and 2, the hereinbefore described configuration of the rotatable disks 13, 14 and 15 causes the indicia carrying surfaces 17 of the three disks to be at

10 progressively greater distances from the player of the slot machine 11. This creates a three dimensional effect that enhances player enjoyment of the gaming apparatus. This can be further enhanced by pulsed illumination at the three indicia displaying surfaces 17. To enable such illumination, the disks 13, 14 and 15 are formed of translucent plastic or other translucent material. Referring jointly to FIGS. 2 and 3, three concentric circular fluorescent light tubes 64

15 are situated behind the disks 13, 14 and 15, the tubes being secured to the front circular support plate 33 by brackets 66. The fluorescent light tubes 64 are centered on the axis of rotation 16 of disks 13, 14 and 15 and have differing diameters. The outermost tube 64 has a diameter corresponding to the diameter of the indicia bearing surface 17 of the front disk 13, the middle tube 64 has a diameter corresponding to the diameter of the indicia bearing surface 17 of the intermediate disk 14 and the diameter of the innermost tube 64 corresponds to the diameter of the indicia bearing surface of the rear disk 15.

[45] A light diffuser plate 67 extends between the fluorescent light tubes 64 and the rear rotatable disk 15 to provide for a more uniform illumination of the indicia bearing surfaces 17 of the disks. The diffuser plate 67 is supported by the previously described brackets 58, 58a and 58.

25 As best seen in FIGS. 4, 5 and 6, the rim of diffuser plate 67 has notches 68 to enable gear sets 32a, 32b and 32c to be situated at their previously described locations.

5 [46] Referring again to FIGS. 1 and 2, strobing of the fluorescent lights 64 on and off attracts the attention of potential players of the slot machine 11 and contributes to player interest during playing of the game. Rapid sequential strobing of the three lights 64 enhances the three dimensional aspect of the indicia display at the face of the slot machine.

[47] The example of the invention described above with reference to FIGS. 1 to 6 embodies a highly advantageous mechanism for supporting and driving the indicia carrying rotatable disks 10 13, 14 and 15. Both functions, supporting and driving, are effected with simple gear sets situated at the periphery of the disks. This eliminates the complex and bulky telescoped shafting and other components at the axis of rotation of the disks which has heretofore been present in slot machines of this general type. The rim drive also makes it possible to include open centered 15 rotating disks which need not extend to the axis of rotation thereby enabling viewing of indicia bands of progressively smaller diameter that are spaced apart along the axis of rotation of the disks. The disk support and drive mechanism in the preferred form is easily removable from the slot machine cabinet as a unit to facilitate repairs.

[48] While the rim driven construction discussed above constitutes the preferred form of the invention, certain novel features of the previously described embodiment can advantageously be 20 embodied in rotating disk slot machines which have center shafting for the purpose of supporting and driving the disks. This includes, for example, axial spacing of the rotating bands of indicia to provide a three dimensional aspect to the indicia array as viewed by the player. FIGS. 7 and 8 depict the disks and disk support and drive mechanism of a slot machine 11b of this kind.

25 [49] Referring jointly to FIGS. 7 and 8, front, intermediate and rear rotatable disks 13a, 14a and 15a respectively, of this embodiment are flat circular plates which are spaced apart along a common axis of rotation 16a. The disks 13a, 14a and 15a have progressively greater outside

5 diameters thereby enabling viewing of an annular region 17a of the front surface of each of the
disks by a player who situated in front of the slot machine which regions are at the radially
outermost portions of the disks. Annular bands of indicia 19a of the previously described kind
are imprinted on the regions 17a of the disks. An interesting effect is created if the annular
regions 17a of the disks 13a, 14a and 15a are beveled surfaces so that the indicia 19a of the three
10 disks are in a coplanar or near coplanar relationship.

[50] Rotatable disks 13a, 14a and 15a are supported and separately rotated by a drive system
69 which includes three coaxial drive shafts 71, 72 and 73 of progressively shorter length. The
back end of the inner drive shaft 71 extends out of intermediate drive shaft 72 and is supported
by a first bearing 74 which is secured to one arm 76 of internal framing 77 within the slot
15 machine cabinet 21a. The front end of inner drive shaft 71 also extends out of the intermediate
drive shaft 72 and has a flange 79 seated in a conforming opening in a circular cap 81 which is in
front of the front disk 13a. Screws 82 extend through the front disk 13a and cap 81 and engage in
flange 79 thereby constraining the disk to rotate with the inner drive shaft.

[51] A second bearing 83, supported by another framing arm 84, supports the intermediate
20 drive shaft 72 at a location which is forward from the back end of the drive shaft 72. A flange 86
at the front end of intermediate drive shaft 72 seats in a conforming opening in the intermediate
rotatable disk 14a and is secured to that disk by additional screws 87. The outer drive shaft 73 is
supported at an intermediate location along the drive shaft by a third bearing 88 which is secured
to another arm 89 of the cabinet framing 77. A flange 91 at the front end of the outer drive shaft
25 73 seats in a conforming opening in the rear rotatable disk 15a and screws 92 secure the rear disk
to the flange.

5 **[52]** Front rotatable disk 13a, intermediate rotatable disk 14a and rear rotatable disk 15a are driven by separate electrical motors 93a, 93b and 93c respectively, motor 93c being behind motor 93b as seen in FIG. 7. The motors 93a, 93b and 93c are secured to brackets 94 which extend from framing 77. Referring again to FIGS. 7 and 8 in conjunction, motor 93a is coupled to the inner drive shaft 71 by a drive belt 96 which engages a pulley 97 that is keyed to the inner
10 drive shaft at a location adjacent to bearing 74. Another drive belt 98 couples motor 93b to the intermediate drive shaft 72 by engaging another pulley 99 which is keyed to the intermediate drive shaft at a location which is between bearings 74 and 83. An annular collar 101 on intermediate drive shaft 72 extends between pulley 99 and bearing 83 to prevent movement of the pulley along the shaft. The third motor 93c is coupled to outer drive shaft 73 by a third drive
15 belt 102 which engages another pulley 103 that is keyed to the outer drive shaft at a location immediately behind the third bearing 88. Another annular collar 104 is adjacent to pulley 103 and is held in place by a set screw 106 to prevent axial movement of the pulley along the shaft. Drive belts 96, 98 and 102 are preferably of the non-slip type which have teeth 107 that engage conforming grooves in the pulleys on which they are engaged.

20 **[53]** Motors 93a, 93b and 93c are brake gear motors of the stepping type similar to those of the previously described embodiment of the invention and function in a similar manner to rotate each disk 13a, 14a and 15a through a predetermined number of angular increments that is determined by the control circuit 54a.

25 **[54]** Three circular timer plates 108, 109 and 111 enable microprocessor tracking of the rotary movement of the disks 13a, 14a and 15a in the previously described manner. Timer plate 108 is disposed in coaxial relationship with inner drive shaft 71 at a location between pulleys 97 and 99 and is secured to an adjacent annular collar 112 which is constrained to rotate with the inner

5 drive shaft by a set screw 113. Timer plate 109 is disposed on intermediate drive shaft 72 in coaxial relationship therewith at a location between timer plate 108 and pulley 99 and is secured to another annular collar 114 which is constrained to rotate with the intermediate drive shaft by another set screw 116. The third timer plate 111 is situated between pulley 103 and bearing 83, in coaxial relationship with the outer drive shaft 73, and is constrained to rotate therewith by
10 another annular collar 117.

[55] The circular rim of each of the timer plates 108, 109 and 111 is indented by a series of notches 118 which have an angular spacing relative to the axis of rotation that corresponds to the hereinbefore described angular increment of rotary motion of the disks 13a, 14a and 15a. A separate one of three photoelectric sensors 119 is disposed at the rim of each timer plate 108, 109
15 and 111 and may be of one of the known types which have a small light source 121 such as a light emitting diode for example and a light detector 122 such as a phototransistor for example that produces an electrical signal in response to light from the source. The light sources 121 and detectors 122 are at opposite sides of the rims of the timer plates 108, 109 and 111 at which notches 118 are located thereby causing light to be transmitted from the sources 121 to the
20 detectors 122 each time that a notch passes between the two. Thus each sensor transmits an electrical pulse to the control circuit housing 54a each time that the associated timer plate 108, 109 or 111 is stepped through the above described angular increment of motion by the associated drive motor 93a, 93b or 93c. As previously described, this enables the microprocessor 56a to cause stopping of the rotation of the disks 13a, 14a and 15a at times when indicia are in
25 alignment at the payline and, by counting the pulses, to determine which indicia are at the payline.

5 **[56]** Components of the slot machine 11a of FIGS. 7 and 8 which are not depicted therein may be similar to those of the previously described embodiment of the invention.

[57] The invention is not limited to slot machines of the motor driven, microprocessor controlled type. Pulleys 97, 99 and 103 may, for example, be spun manually by the player preferably with lever arm operated mechanism of the kind found in older forms of slot machine.

10 Embodiments of the invention of this kind do not necessarily require timer plates 108, 109 and 111 and sensors 119.

[58] In the embodiment of the invention which has been described with reference to FIGS. 1 to 6, visibility of indicia on disks which are behind other disks is provided for by using disks which are open centered except for the rear disk. In the embodiment which has been described
15 with reference to FIGS. 7 and 8, visibility of the successive bands of indicia is provided for by using disks of progressively greater diameter. Referring jointly to FIGS. 9 and 10, visibility of the bands of indicia can also be realized in a construction where the rotatable disks 13b, 14b and 15b have the same outside diameter and are not necessarily open centered. An advantage of disks which have the same diameter is that they may then be driven by simple gearing situated at the
20 periphery of the disks.

[59] Disks 13b, 14b and 15b carry annular bands of indicia 19b of progressively smaller diameter and which may be of the previously described kind. The front disk 13b, intermediate disk 14b and rear disk 15b each have gear teeth 31b at the peripheries of the disk. Disks 13b, 14b and 15b are supported by a vertically extending internal frame member 123 within the slot
25 machine cabinet 21b and are positioned to be viewable through the transparent front window 22b of the cabinet. In particular, an axle 124 extends forward from frame member 124 through the centers of the disks 13b, 14b and 15b and has a flange 126 at its forward end which acts to retain

5 the disks on the axle. Each of the disks 13b, 14b and 15b is rotatable about axle 124 and preferably a pair of thin, flat annular shims 127 encircle the axle between the disks, between front disk 13b and flange 126 and between rear disk 15b and frame member 124 to create a small spacing between these components.

[60] Disks 13b, 14b and 15b are each driven by a separate electrical motor 128a, 128b and 10 128c respectively which motors are similar to the drive motors of the previously described embodiments of the invention. Each such motor 128a, 128b and 128c turns a shaft 129 that extends in a direction parallel to the axis of rotation 16b of the disks and which has a spur gear 131 at its forward end which engages the gear teeth 31b of the particular disk 13b, 14b and 15b that is driven by the particular motor. In this example, motor 128b which drives the intermediate 15 disk 14b is situated directly below the axis of rotation 16b of the disks. Motor 128b which drives the front disk 13b and motor 128c which drives the rear disk 15b are at opposite sides of the axis of rotation 16b and at a higher elevation.

[61] Photoelectric sensors 119b for producing signals that track rotation of the disks 13b, 14b, 15b in the previously described manner do not necessarily require timer plates of the previously 20 described kind if the gear teeth 31b of the disks are formed of opaque material or if the teeth have an opaque coating. The sensors 119b may simply be positioned to direct light towards the gear teeth 31b and to respond to transmission of light through the openings between successive gear teeth.

[62] Appearance of the slot machine can be enhanced by providing an opaque mask 132 on 25 the cabinet window 22b that is configured to conceal the peripheral regions of the disks 13b, 14b, 15b at which the gear teeth 31b are located.

5 [63] The annular bands of indicia 19b of the successive disks 13b, 14b and 15b are of progressively increasing diameter in this embodiment but can be of progressively diminishing diameter in other embodiments. In either case, viewing of each of the bands of indicia 19b is enabled by forming the disks of transparent material such as transparent plastic or at least the regions of the front disk 13b and intermediate disk 14b that are in front of a band of indicia of
10 another disk are formed of such material.

[64] Except as herein described, the slot machine of FIGS. 9 and 10 may be similar to the embodiment of the invention which has been previously described with reference to FIGS. 1 to 6.

[65] The embodiments of the invention which have been herein described for purposes of
15 example have rotating disks which extend in vertical planes. The disks and disk drive and support systems can be reoriented so that the disks extend in horizontal planes or have an inclined orientation.

[66] The herein described examples of the invention are slot machines of the type used in gambling casinos that require insertion of coins or paper currency and which pay monetary
20 rewards to successful players. The apparatus can also be configured as an amusement device that does not require nor pay out money and wherein the player or players simply earn points when particular indicia come to rest at particular locations or align in particular combinations at such locations.

[67] While the invention has been described with respect to certain specific embodiments for
25 purposes of example, many modifications and variations are possible and it is not intended to limit the invention except as defined in the following claims.